

Lesson Title: Toy Car Lab

Subject area/ Course/grade level: Science/ Motion/ 5th Grade

Introduction:

Lesson Length: 2 hours

Materials: Constant Velocity Toy Car, Stop Watches, Metersticks, Computers with graphing software such as ChartTool (<http://www.onlinecharttool.com>).

Lesson Overview: Students will collect data of the motion of a toy car. The data will be graphed on a computer.

Tennessee Standards:

GLE 0507. Inq. 2. Select and use appropriate tools and simple equipment to conduct an investigation.

GLE 0507. Inq.3. Organize data into appropriate tables, graphs, drawings, or diagrams.

0507. Inq. 2. Identify tools needed to investigate specific questions.

0507. Inq. 3. Maintain a science notebook that includes observations, data, diagrams, and explanations.

0507. Inq. 4. Analyze and communicate findings from multiple investigations of similar phenomena to reach a conclusion.

GLE.0507.11.1 Design an investigation, collect data and draw conclusions about the relationship among mass, force, and distance traveled.

Lesson Objectives: To investigate the motion of two toy cars to determine why their motion is different.

ENGAGEMENT

- Using their lab notebooks, students will be asked to observe the motion of two toy cars (one fast and one slow) and to describe their motion. They are then asked to predict what a graph of distance versus time would look like. After time is given for students to record their personal thoughts, they are then divided into groups of three or four and asked to show their descriptions of motions and graphs on their white boards. When all boards are complete and displayed to the class, allow each group to explain their board to the class. (Try not to make any statements as to whether the information presented is correct or incorrect.) Make sure the following questions have been addressed after the discussion:

- 1) How does the motion of the two cars differ?
- 2) Is the speed of the cars changing or staying the same?
- 3) How can we determine if the speed is staying constant?

4) What equipment would we need to do this investigation?

5) How would we record our data?

EXPLORATION

- Provide instruction on how to keep a laboratory notebook showing materials, equipment and data table.
- Explain to students that we want time to be the independent variable (plotted on the horizontal axis) and distance to be the dependent variable (plotted on the vertical axis).
- Divide students into groups of three or four. Provide students with metersticks, stopwatches, post-it notes, and Battery Operated Toy Cars and explain to them good techniques needed to collect data.
- Students should place a post-it note on the floor to mark the zero position, turn the car on and place it on the floor so that the back of the car is lined up with the post-it note. Release the car and start the stop watch at the same time. After 4 seconds, the students need to place a post-it note on the floor behind the car to make the car's position. Repeat this at the 8 second mark, 12 seconds and so on until all of the seven post-its have been used up. Stop the car and use a meter stick to measure the distance from the zero position to each post-it note. Record the distances in the data table.
- Have each group present their data table on their whiteboards to show to the class.

ELABORATION

- After all groups have finished collecting their data, ask the students if they are able to determine from the data table if the toy cars were moving at a constant speed. Ask them if they think a graph would help them decide if the cars were moving at a constant speed.
- Have each group go to the free online graphing program (<http://www.onlinecharttool.com>) and graph their data. Provide each student with a handout containing specific instructions on how to use the software. After each group has graphed their data, have them sketch their graph on their whiteboard. After each group has finished their white board, have them present them to the class. Ask the following questions:
 - 1) What do all of the graphs have in common?
 - 2) What do they think the straight line means?
 - 3) Are there any differences in the graphs?
 - 4) What is the formula for speed?
 - 5) What part of this graph represents speed?
 - 6) What does a graph with constant speed look like?
 - 7) How would a graph with speed that is changing appear?

8) How do the graphs from the slow cars differ from the graphs of the fast cars?

9) What is causing the difference in distance?

- Open the battery compartments of a fast and a slow car and allow the students to see what has been done to each car.

10) Ask the students about how the force applied by the battery is different between the cars. If each battery is able to apply a certain amount of force to the gear system of the car, then what happens to the force when one battery is removed?

11) What happens to the distance when the force is decreased?

- After the discussion, allow each group time to print their graph and glue it in their lab book. (If printing the graph is not possible, then have each student sketch the graph in their lab notebook.

EVALUATION

Students need to write a conclusion to their lab activity. Questions that need to be answered in their lab books:

- 1) Describe the motion of the toy car. How do you know?
- 2) What does a graph of an object with constant speed look like?
- 3) How does a graph of a fast object differ from the graph of a slow object?
- 4) How does the force applied to the car (from the battery) affect the distance the car travels?
- 5) Using the formula $\text{speed} = \text{distance}/\text{time}$, calculate the speed of your toy car.

Reference:

Adapted from the Modeling Physics Curriculum Constant Velocity Unit developed by Arizona State University. (©Modeling Workshop Project 2002)

Equipment Sources

To purchase the toy car:

1) at around \$2.50 each (This requires a minimum amount):

Mark Tibor, Account Executive
Westminster Inc.
Toll Free: (800) 257.0824
Direct: (404) 917.2368
Fax: (888) 228.2082
Email: mark@westminsterinc.com

2) at around \$8.00 each:

Arbor Science at http://www.arborsci.com/prod-Constant_Velocity_Car-50.aspx. Search for
Constant Velocity Car Product ID: 44-1090.